Office and Retail Model Adjustments - Direction for SRA
Date Updated: March 3, 2015

Objective

An analysis of the existing Retail and Office models found a bias in favor of buildings with extremely high values for certain operating characteristics. Adjustments at these extremes resulted in unfairly high ratings. EPA has decided to cap the adjustment for certain operating characteristics to correct this trend.

The desired changes to the Office and Retail models are documented herein. They are targeted for release on April 15, 2010 and they should be applied within Portfolio Manager, Target Finder, and in the Automated Benchmarking System. Also, EPA will need to review and approve a score change report to assess the impact of these changes prior to the April release. This document presents a summary of the changes, the implications of these changes for buildings with multiple spaces, and the requirements for preparatory score change reports.

Timeline

Final technical direction to SRA	December 11, 2009
SRA/EPA meeting to review direction document	TBD
Score change report delivered to EPA	TBD
EPA approval of score change report	TBD
Final public release date	April 15, 2010

Summary of Changes

There will be one change to the Retail model and two changes to the Office model, as follows:

Retail Model - Register Density Cap

EPA is capping the register density adjustment for retail buildings at 0.71 registers per 1,000 square foot. If a building has a register density above 0.71, it should receive an EUI adjustment equal to that of a building with a register density of 0.71. In the process of computing the rating, it will be necessary to compute two separate values for Register Density: Register Density Actual and Register Density Capped. The capped value should be used in all rating calculations. The equation for Predicted Source EUI remains the same, as detailed below, with the capped value used in place of the actual value.

Predicted Source EUI (kBtu/ft^2) = 153.1
+ 20.19 * (LNSqFt – 9.371)
+ 1.373 * (Wkhrs – 63.74)
+ 61.76 * (WkRDen – 0.6279)
+ 70.6 * (PCDen – 0.3149)
+ 249.1 * (RgstrDenCap – 0.1905)
+ 720.2 * (WalkinDen – 0.0038)
+ 81.9 * (RfgCommDen – 0.0450)
+ 0.0113 * (HDDxPH – 3811)
+ 0.0125 * (CDDxPC – 972.1)

Following is an example of Predicted Source EUI calculations for three sample buildings: one below the cap, one equal to the cap, and one above the cap. All other building characteristics used in the calculation of Predicted Source EUI are listed below:

- Gross Floor Area (sqft.) = 70,000
- Weekly Operating Hours = 70
- Workers on Main shift = 8
- Number of personal computers = 3
- Percent Heated = 100%
- Percent Cooled = 100%
- Number of walk-in refrigeration/freezer cases = 0
- Number of open and closed refrigeration/freezer cases = 7
- HDD = 3850
- CDD = 2300

Table 1: Retail Predicted Source EUI with Register Density Cap

Number of Registers	Square Footage	Register Density Actual	**Register Density Capped**	Reference Value	Centered Value	**Source EUI**
30	70000	0.43	**0.43**	0.1905	0.238	**224.92**
50	70000	0.71	**0.71**	0.1905	0.524	**296.09**
70	70000	1.00	**0.71**	0.1905	0.524	**296.09**

Office Model – Square Foot and Personal Computer Density Caps

EPA is capping the square footage adjustment for office buildings at 200,000 square feet. If a building is larger than 200,000 square feet. The square foot adjustment in the equation should be equal to that of a building with 200,000 square feet. In the process of computing the rating, it will be necessary to compute two separate values for Square Feet: Square Feet Actual and Square Feet Capped. The natural log of the capped value should be used to compute the square foot term in the regression equation***. The actual value should be used for all display purposes, and to calculate the densities for relevant operating characteristics*** (e.g. personal computer density and worker density. Actual values would also be applied to compute weighted averages for buildings with multiple office spaces, such as the combined weighted hours per week and percent heated/cooled).

In addition to the square foot cap, EPA is capping the personal computer density adjustment for office buildings at 11.1 computers per 1000 square foot. If a building has a personal computer density above 11.1, the computer density adjustment in the equation should be equal to that of a building with a personal computer density of 11.1. In the process of computing the rating, it will be necessary to compute two separate values for Personal Computer Density: PC Density Actual and PC Density Capped. The capped value should be used in the regression equation.

The equation for Predicted Source EUI remains the same, as detailed below, with the capped values substituted.

Predicted Source EUI (kBtu/ft^2) = 186.6
+ 34.17 * (LNSqFtCap – 9.535)
+ 17.28 * (PCDenCap – 2.231)
+ 55.96 * (LNWkHrs – 3.972)
+ 10.34 * (LNWkrDen – 0.5616)
+ 0.0077 * (HDDxPH – 4411)
+ 0.0144 * (CDDxPC – 1157)
- 64.83 * [BANK_50 * (LNSqFtCap – 9.535)]
+ 34.20 * [BANK_50 * (LNWkrDen – 0.5616)]
+ 56.30 * [BANK_50]

Note that the capped value for square feet can be used in the Bank terms for consistency. However, it is not technically necessary in this term because the square footage must be under 50,000 to apply the Bank terms.

It is important to note that a building could exceed either the square foot cap or the personal computer density cap, or both. In determining what caps are exceeded, note that the computer must be computed with the ***actual square foot***.

The following example demonstrates the predicted source energy use of three buildings with different square foot values (150,000, 200,000, and 250,000), and therefore different personal computer densities and different worker densities. For each of these buildings, all other operating characteristics are identical, as follows:

- Weekly Operating Hours = 80
- Workers on Main Shift = 250
- PC = 2000
- Percent Heated = 100
- Percent Cooled = 100
- HDD = 4937
- CDD = 1046

To compute the rating, the computer density must be computed and compared with the maximum allowed density (cap value). The actual square foot is applied in performing this calculation and comparison. Then, separately, the actual square foot must also be compared with its maximum allowed (cap value). This determines what value for LN(Square foot) and PCDensity are to be applied in the regression equation.

Table 2 presents a number of these interim calculations along with the regression equation and predicted EUI for each example building.

Table 2: Office EUI Predictions with Square Foot and PC Density Caps

	Building 1	Building 2	Building 3
Square foot	150,000	200,000	250,000
PC Density	13.333	10.000	8.000
LN(Worker Density)	0.511	0.223	0.000
Capped Square foot	150,000	200,000	200,000
LN(Capped Square Foot)	11.918	12.206	12.206
Capped PC Density	11.1	10.000	8.000
Regression equation	Predicted EUI= 186.6 **+ 34.17*(11.918 – 9.535)** **+ 17.28*(11.1 – 2.231)** + 55.96*(4.382 – 3.972) **+ 10.34*(0.511 – 0.5616)** + 0.0077*(4937 – 4411) + 0.0144*(1046 – 1157)	Predicted EUI= 186.6 **+ 34.17*(12.206 – 9.535)** **+ 17.28*(10.000 – 2.231)** + 55.96*(4.382 – 3.972) **+ 10.34*(0.223 – 0.5616)** + 0.0077*(4937 – 4411) + 0.0144*(1046 – 1157)	Predicted EUI= 186.6 **+ 34.17*(12.206 – 9.535)** **+ 17.28*(8.000 – 2.231)** + 55.96*(4.382 – 3.972) **+ 10.34*(0.000 – 0.5616)** + 0.0077*(4937 – 4411) + 0.0144*(1046 – 1157)
Predicted Source EUI	**446.169**	**434.016**	**397.149**

Implication of changes for buildings that contain multiple spaces

The standard procedure for combining multiple spaces is to combine all attributes and apply the regression equation a single time for each space type. This basic format will still be applied, all attributes should be combined into a single combined space, and then the cap should be applied if it is required.

- For buildings with multiple retail spaces, the register density should be computed across all retail spaces, and then the cap should be applied.
- For buildings with multiple office spaces, the square footage and personal computer density should be computed across all office spaces, and then the caps should be applied.
    - For example, if a building consists of a 100,000 and a 150,000 square foot office spac, the actual building size is 250,000 square feet. With the cap in place, the square foot value used in the rating model is 200,000.

Score Change Report

EPA will require two score change reports (in Excel) in order to test the model adjustments, verify SRA scripts, and prepare the commercial outreach team for the new rating adjustments. The score change reports should be similar to the report created for the August 2009 Religious

Worship Model. All buildings in Portfolio Manager that contain a Retail space should be included in one report, and all buildings that include an Office space should be included in the other report.

Note that a separate score change report is being requested for the new Data Center model, in addition to the two reports for Office and Retail. Buildings that have a combination of Office, Retail, and Data Center spaces should appear in all reports that apply, reflecting all changes.

It is EPA's intention that the information contained in this report will provide all required fields so that the ratings can be completely replicated. If SRA has any questions or identifies any missing elements, it would be useful if they could alert EPA prior to generating the report. This way, the reports should be complete the first time they are created.

The sample should be drawn to include all buildings that:

1. Have at least one Retail space for the Retail report
2. Have at least one Office space for the Office report
3. Are not labeled "Test" or "Sample"
4. Are not owned by EPA or its contractors

In addition, please note the following:

1. The Data Center model is also scheduled to change on April 15, 2010. Hence, the ***new ratings in all score change reports should reflect the Retail, Office, and Data Center changes***.
    a. EPA has requested a separate report to analyze the Data Center changes. A building with Retail or Office space as well as Data Center space should appear in all applicable reports.
2. The list of desired column headings is attached at the end of this document. This list is similar to the list requested for August 2009 testing.
3. All numbers should be displayed/stored as numbers (not as text/strings)
4. All yes/no variables (for example Presence of Cooking) should be displayed as either 1 or 0 (for Yes or No). Please do not display these as coefficient values.
5. All attribute values (including square foot) should be presented as the time-weighted attribute values that are used to predict the Source EUI for the building.
6. The attribute values for non-Retail and Office space should only be included if the sample contains a building with that space. (e.g. if there are no buildings in the sample that contain supermarkets, then there is no need for any supermarket attribute columns).
7. Percent Heated/Percent Cooled should be reported as fractions between 0 and 1 (i.e. the values that are used in the equations).
8. The "count of primary spaces" should reflect the total number of spaces, not the total number of space types. For example, a building with 5 Office spaces has 5 primary spaces (not 1).

Attachment – Summary of Attributes for Score Change Report

Table A.7 – Summary of Columns for Data Center Score Change Report				
General Information	**Data_Center**	**Parking**	**Hotel**	**Warehouse_UNRFG**
Building ID	Data_Center_Floorspace	Parking_TotalFloorspace	Hotel_Floorspace	Warehouse_UNRFG_Floorspace
Old Rating	Data_Ceneter_AnnualPDU_Energy	Parking_OpenFloorspace	Hotel_RoomNumber	Warehouse_UNRFG_Hours
New Rating	Data_Center_AnnualUPS_Energy	Parking_EnclosedFloorspace	Hotel_Workers	Warehouse_UNRFG_Workers
Delta Rating	Data_Center_AnnualIT_Energy	Parking_NotEnclosedFloorspace	Hotel_Cook	Warehouse_UNRFG_WalkinRfgNum
ZIP Code	Data_Center_Hours	Parking_Hours	Hotel_CommRfgNum	Warehouse_UNRFG_PercentCooled
Total Sq Ft (w/o Parking)	**Office**	**Swimming Pool**	Hotel_PercentCooled	Warehouse_UNRFG_PercentHeated
Total Sq Ft (w/Parking)	Office_Floorspace	SwimmingPool_Size	Hotel_PercentHeated	**Warehouse_RFG**
Building Type	Office_Hours	SwimmingPool_Months	Hotel_Laundry	Warehouse_RFG_Floorspace
Label (Y/N)	Office_Workers	SwimmingPool_IndoorOutdoor	Hotel_AvgOccupancy	Warehouse_RFG_Hours
Most Recent Label Year	Office_PCNum	**Medical_Office**	**Religious Worship**	Warehouse_RFG_Workers
Label Year(s)	Office_PercentCooled	Medical_Office_Floorspace	Worship_Floorspace	Warehouse_RFG_WalkinRfgNum
Total Site Energy (kBtu)	Office_PercentHeated	Medical_Office_Hours	Worship_Seats	**Supermarket**
Total Source Eneryg (kBtu)	**Bank**	Medical_Office_Workers	Worship_Weekdays	Supermarket_Floorspace
Weather Normalized Source Energy (kBtu)	Bank_Floorspace	Medical_Office_PercentCooled	Worship_Hours	Supermarket_Hours
Secondary Space Source Energy (kBtu)	Bank_Hours	Medical_Office_PercentHeated	Worship_PCs	Supermarket_Workers
Predicted Source Energy (kBtu)	Bank_Workers	**Dormitory**	Worship_Cook	Supermarket_Cook
Predicted Swimming Pool Energy	Bank_PCNum	Dormitory_Floorspace	Worship_CommRfg	Supermarket_WalkinRfgNum
CDD_Actual	Bank_PercentCooled	Dormitory_Rooms	Worship_PercentHeated	Supermarket_PercentHeated
HDD_Actual	Bank_PercentHeated	Dormitory_PercentCooled	Worship_PercentCooled	Supermarket_PercentCooled
CDD_30YrAvg	**Court**	Dormitory_PercentHeated	**K12**	Supermarket_OpnClsCaseNum
HDD_30YrAvg	Court_Floorspace	Dormitory_CompLab	K12_Floorspace	Supermarket_PCRegisterNum
YesNo_30yrAvg_Used	Court_Hours	Dormitory_Dining	K12_HighSchool	**Retail**
Number of Secondary spaces	Court_Workers	**Hospital**	K12_PCNum	Retail_Floorspace
Number of Primary spaces	Court_PCNum	Hospital_Floorspace	K12_OpenWE	Retail_Hours
Ownership Information	Court_PercentCooled	Hospital_BedNum	K12_Cook	Retail_Workers
BLDG_OWNER_NAME	Court_PercentHeated	Hospital_MaxFloors	K12_WalkinRfgNum	Retail_PCNum
PM_SURVEY_ORG_NAME	**Other**	Hospital_TertCare	K12_PercentCooled	Retail_CashRegisterNum
BDA_USERID	Other_Floorspace	Hospital_Laboratory	K12_PercentHeated	Retail_WalkinRfgNum
BDA_NAME	Other_Hours	Hospital_Laundry	K12_Months	Retail_OpnClsCaseNum
BDA_EMAIL	Other_PCs	Hospital_BuildNum		Retail_PercentCooled
LABEL_OWNER_ORG_NAME	Other_Workers	Hospital_Owner		Retail_PercentHeated
LABEL_PROPMGR_NAME	Other_OtherType			
Building Name				